Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands	)	WT Docket No. 02-146
Loea Communications Corporation Petition for Rulemaking	)	RM-10288

COMMENTS OF CISCO SYSTEMS, INC.

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SUMMARY

Cisco, commenting only on the 71-76 GHz and 81-86 GHz bands, commends the Commission's efforts to make this spectrum available quickly. Cisco urges the Commission to optimize its rules so that these bands can be used for high-density, multi-gigabit wireless devices that can be used by carriers and enterprises alike to expand the availability of broadband connectivity.

Radios in these "W-band" frequencies can deliver a number of impressive public-interest benefits. They are capable of extremely high bandwidths previously attainable only with fiber-optic cable; they are much faster, easier, and less expensive to install than fiber; and they provide a more flexible network architecture than fiber. In addition, the propagation characteristics of the band offer the possibility of practically limitless frequency re-use. However, for these benefits to be realized, the Commission must adopt "enterprise-friendly" rules that make it possible for users to extend their own broadband capabilities independently of the investment decisions of traditional carriers. (See Part I.)

Cisco generally supports the Commission's allocation proposals for both the 71-76 GHz and 81-86 GHz bands. For the most part, these proposals prudently minimize the potential for future conflicts among users of the bands. However, some of the footnotes proposed in each band for the U.S. Table of Allocations raise troubling issues about the extent to which commercial users will co-exist with government and scientific operations in these bands. (See Part II.)

Cisco urges the Commission to keep its "band plan" for these frequencies as simple as possible. The 71-76 GHz band should be paired with the 81-86 GHz band, and neither band

should be channelized. Furthermore, the Commission should not segment either band to separate Government users from non-Government users, or satellite users from terrestrial users. Instead, the Commission should focus its efforts on the creation of a single, uniform coordination process that covers all users of the bands. Any national security concerns among Government users should be addressed by the creation of one or more "Trusted Path Coordinators" who would receive the clearances necessary to permit them to process coordination requests much faster than is possible with the Interdepartmental Radio Advisory Committee process. (See Part III.)

Cisco urges the Commission to reject geographic licensing in favor of a site-by-site regime. However, in order to address concerns about administrative burdens, the Commission should adopt a blanket licensing regime according to which each operator would receive an FCC license for its first link but would then be permitted to add additional links simply by hiring a path coordinator to coordinate the additional links and notify the FCC that they have been successfully coordinated. Cisco notes that unlicensed use would not be suitable for application to the 70/80 GHz bands, both because users are likely to want full interference protection for these applications, and also because the need for professional installation, site surveys, roof or tower rights, etc. distinguishes these bands from the more consumer-oriented bands in which unlicensed use has been such a great success. (See Part IV.)

Cisco supports the Commission's proposed operational rules and suggests various improvements. The most important of these is Cisco's proposal for the establishment of an accreditation regime for path coordinators, together with a requirement that all coordinations be conducted by an accredited path coordinator. Cisco believes this change would materially increase the speed and reliability of the coordination process. (See Part V.A.) Cisco also offers

a package of refinements to the proposed technical rules, intended to increase consumer acceptance and the potential density of deployment. (See Part V.B.)

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Cisco Systems, Inc. hereby comments on the Commission's Notice of Proposed Rulemaking regarding allocations and service rules in large portions of the 71-95 GHz band.[1] The public and private development of affordable equipment for high-density, multi-gigabit operation in these largely vacant frequencies represents an important contribution to the push for widespread availability of broadband access, and the Commission is to be commended for its efforts to make the spectrum available to the public as quickly as possible and in the most efficient manner. Cisco believes that making these bands available is important and consistent with the goals of the recently released Spectrum Policy Task Force report. Cisco is particularly interested in the Commission's proposals for the 71-76 GHz and 81-86 GHz bands. The Commission's proposal to pair these two blocs of spectrum and make them available without channelization should be adopted as quickly as possible so that the benefits of the latest wireless broadband technology can be brought to the American public as soon as possible.

[1] *Notice of Proposed Rulemaking*, FCC 02-180 (June 28, 2002).

It is important to emphasize at the outset what a tremendous opportunity lies within the Commission's grasp. Radios operating in these "W-band" frequencies can provide fiber-like bandwidths without any of the costs, delays, or disruptions associated with fiber installation, and the resulting radio-based network architecture will have the added benefit of being more flexible. In addition, this technology will empower individual enterprises to make their own broadband connections in buildings that lack fiber connectivity, thus promoting greater broadband availability without the need for intensive up-front investment by traditional carriers. But for these potential benefits to be realized, the Commission must ensure that the rules adopted in this proceeding foster the flexibility that is inherent in the technology, rather than hindering it. From the customer's perspective, obtaining a license for a W-band link should be as easy as going to a website, typing in the desired coordinates, and confirming that the path is available without creating harmful interference to incumbent users. That ideal should be kept front and center throughout all aspects of this rulemaking.

In these comments, Cisco first recapitulates all the public interest benefits that have been identified for the radios operating in these "W-band" frequencies. Second, Cisco expresses its general support for most of the Commission's allocation proposals for the 71-76 GHz and 81-86 GHz bands, and suggests several respects in which those proposals might be improved. Third, Cisco discusses various "band plan" issues, of which the most important are (a) the Commission's decision not to propose any subdivision of the 71-76 GHz and 81-86 GHz bands, a decision which Cisco applauds; and (b) the related issue of how to facilitate shared Government and non-Government use of these frequencies. Fourth, Cisco outlines a proposed licensing procedure that will allow large and small enterprises alike to realize the benefits of W-band technologies as quickly, flexibly, and inexpensively as possible. Finally, Cisco comments

on the operational and technical service rules proposed by the Commission for the 71-76 GHz and 81-86 GHz bands, presenting a proposal for streamlined path coordination as well as a package of technical specifications that Cisco has crafted for the express purpose of maximizing both spatial efficiency (or frequency reuse) and consumer acceptance.

I. THE COMMISSION CAN AND SHOULD EXPAND BROADBAND AVAILABILITY IN THIS PROCEEDING BY EMPOWERING CONSUMERS AND BUSINESS ENTERPRISES

The NPRM in this proceeding grows out of the petition for rulemaking filed last year by Loea Communications Corporation.[2] In that petition and in the comment cycle that it spawned, commenters enthusiastically described the potential benefits of making the 71-76 GHz and 81-86 GHz frequencies available for commercial use. The Commission recounted many of these benefits in the NPRM.

Cisco emphatically agrees with the public interest benefits that have already been noted in the record. First and foremost, the technology that has been developed for the 71-76 GHz and 81-86 GHz bands will provide bandwidths previously attainable only with fiber optic cable (OC-192 speeds and beyond) without the costs, delays, or disruptions associated with trenching fiber. Some estimates place the cost of trenching fiber in metropolitan areas as high as $110 per foot; by contrast a W-band radio link could provide equivalent performance for distances of up to 3-4 km for as little as $10 per foot. Furthermore, as anyone who resided in a major metropolitan area during the Great Fiber Building Frenzy of the late 1990s can attest, fiber installation is highly disruptive, affecting everything from automobile traffic to network reliability. In fact some cities, including San Francisco, San Diego, and Washington, D.C., have enacted local restrictions that limit digging on streets that have recently been resurfaced. And a typical fiber

[2] Loea Communications Corporation Petition for Rulemaking, Docket No. RM-10288 (filed Sept. 10, 2001).

installation can take months, whereas a radio link can be established in just days (or even hours in an emergency). W-band radios therefore provide network designers with a fast and economical way to address the barriers that keep so many enterprises locked in the narrowband world, despite the fact that 75% of U.S. businesses are within 1 mile of fiber.

Furthermore, wireless multi-gigabit radios in the 71-76 GHz and 81-86 GHz bands will promote much more flexible network architectures. W-band radios can be deployed in days rather than months, and can be re-deployed to suit the user's evolving needs. Hence, a business with two or more offices in the same city can use W-band radios for network interconnection without fear that the investment will be stranded if and when any one of the locations moves. And unlike fiber-based networks, wireless multi-gigabit networks promote greater competition among broadband service providers because the occupants of any given building can access almost *any* nearby fiber network – not just the one to which their building may happen to be connected. Indeed, only a small minority of commercial enterprises currently have even *one* available avenue for true fiber connectivity; a recent study by one vendor estimated that only 5% of commercial office buildings in the U.S. were connected directly to fiber loops.

In addition, wireless operations in the W band hold out the promise of almost limitless frequency re-use. The narrow beamwidths and relatively short path distances will enable the deployment of these radios so densely that for all practical purposes scarcity need never occur in these bands. Each two-way link forms what can be conceived as a spatial, broadband pipe, and an arbitrarily large number of these pipes can be accommodated in any given metropolitan area.[3]

[3] Cisco envisions two different network topologies: random and "hub-and-spoke." The random deployment model characterizes the sort of deployment that would result from a steady accumulation of independent links wherever needed by individual enterprises. An aerial view of these links would appear as though the locations had been randomly assigned. By contrast, the hub-and-spoke model characterizes the sort of deployment that would result from a moderately large number of links all terminating at a common "fiber hotel." In the hub-and-spoke model, the hub is typically a large building with both a connection to the Internet backbone and good line of sight to many other buildings in the vicinity. The spokes are built up over time as surrounding buildings

For the purpose of this filing, Cisco defines a spatial pipe to include all 70/80-GHz spectrum in one polarization between two end points.

Despite the often rancorous debate that surrounds many issues of telecom regulation, there is nearly universal consensus that the expansion of broadband connectivity to more American homes and businesses is perhaps the most important objective facing both private decision-makers and public policy-makers today. Until now, this has been conceived largely as a matter of getting commercial carriers to extend their networks to consumers – the latter being mostly passive characters in the drama who are unable to do much about broadband connectivity until carrier service is available. Deployments of new fiber facilities, however, have declined 52% this year on an annual basis.[4] Fiber deployment within the United States, as measured in fiber kilometers, is not expected to return to 2001 levels even through the end of 2006.[5]

The dominant, carrier-centric approach depends upon capital investment by providers who already have significant debt burdens and cannot easily raise new equity in the current investment climate. But this dominant view overlooks an important factor in the development and growth of broadband networking: Carriers do not originate traffic; consumers and business enterprises do. In many cases, access to a broadband network is not only critical to a company's ability to generate revenue and provide services to its customers, but is also imperative as an intra-company communication and productivity tool. Speed to market and competitive

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are brought wirelessly online. Note that in "hub-and-spoke" deployments, the hub is really a collection of point-to-point wireless terminals and not the terminus of a true point-to-multipoint system. Moreover, different spokes of the same hub could potentially be operated by different licensees. In the course of these comments, Cisco will point out how the Commission's policy choices should be influenced by the need to accommodate both these deployment models.

[4] KMI Research, "Worldwide Fiber Demand Falls with Completion of North American Backbones," Fiber Optics Market Intelligence (Oct. 17, 2002) (available at http://www.kmiresearch.com/downloads/fmi021015.pdf).

[5] *Id.* The author of another recent report estimated that at current levels of fiber deployment, it would take 35 years for 80% of U.S. office buildings to have true fiber connectivity. *See* Mary Jander, "ILECs' Missing Links," Light Reading (Sept. 6, 2002) (available at http://www.lightreading.com/document.asp?doc_id=20816).

advantage often depend on the availability of these high-speed communications facilities. It is often, therefore, a matter of economic necessity for such customers to get access to bandwidth quickly, through a speedy carrier deployment or the ability to deploy communications equipment themselves, enabling rapid expansion and response to business conditions. In both scenarios, high-speed, wireless networking represents a viable alternative.

From consumer-priced WiFi devices for homes to more sophisticated gear for universities and corporations, wireless broadband connectivity has been growing exponentially. Business enterprises, in particular, have recognized that Wireless Local Area Networking increases productivity in a cost-efficient way. Moreover, commercial enterprises have capital at their disposal that carriers do not, as well as their own internal cost-reduction and revenue-production business drivers. Business spending on networking equipment is expected to increase by 4% in 2002, 14% in 2003, and by 13% in 2004.[6] The bottom line is that policy-makers interested in promoting broadband development must increasingly think not only about the telecommunications industry, but also about how wireless technologies can directly and positively affect enterprises in other sectors.

The advent of W-band radios will be a boon to carriers and enterprises alike. Carriers will likely be attracted to W-band radio for backhaul for mobile systems, fiber service restoration and extension, and "last-mile" (a.k.a. "first mile") solutions for their customers. Enterprises will be attracted by the potential for campus network interconnection and fiber-equivalent connectivity to the internet. All parties will benefit from the potential for speedy, flexible, and cost-effective deployment. The Commission's proposal to make these frequencies available for immediate licensing is good news for everyone.

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[6] Morgan Stanley Research, Data Networking/Internet 2002 Outlook, January 2002.

II. CISCO SUPPORTS MOST OF THE PROPOSED CHANGES TO THE ALLOCATION TABLE

The NPRM details a number of proposed changes to the U.S. Table of Allocations, many of which arise directly from recent World Radiocommunication Conferences. With respect to the 71-76 GHz and 81-86 GHz bands, Cisco generally supports the Commission's proposals. However, the Commission either proposes or seeks comment on a small number of changes that Cisco cannot support.

A. Allocation Proposals for the 71-76 GHz Band

Cisco either supports or does not oppose the majority of the Commission's allocation proposals for the 71-76 GHz band. Specifically, Cisco supports (1) reallocating the 75.5-76 GHz band to Fixed, Mobile, and FSS downlinks while deleting the existing Amateur and AMSAT allocations; (2) changing the transmission direction for satellite services from uplink to downlink; (3) revising footnote US297 to move BSS feeder links from the 74-75.5 GHz band to the 81-82.5 GHz band; and (4) deleting footnote US270 (effectively removing RAS from the 72.77-72.91 GHz band).

In addition to the foregoing, the Commission proposes to add footnote USyyy, authorizing secondary Amateur and AMSAT use of the 75.5-76 GHz band until January 1, 2006. Cisco believes that the full 71-76 GHz band should be available for Fixed use no later than January 1, 2004, and therefore questions the wisdom of this proposal. Although the proposed footnote allocation is only for secondary use, the Commission should take due notice of the difficulty of identifying the source of interference from Amateur operations. In light of the ready availability of alternative Amateur and AMSAT spectrum at 77.5-78 GHz, Cisco believes that terminating the secondary allocation at 75.5-76 GHz as of January 1, 2004 would better promote the development of the 71-76 GHz band without any real inconvenience to Amateur operations.

The Commission also proposes to add footnote USwww, which would prohibit stations in the Fixed, Mobile, and Broadcasting services from causing harmful interference to stations in the Federal Government Fixed-Satellite Service in the 74-76 GHz band. Cisco does not oppose this proposal at this time, because Cisco assumes that FSS operations by the Federal Government in the 74-76 GHz range would involve a relatively small number of earth stations at relatively remote locations. However, Cisco cannot affirmatively support the proposal at this time, because the proposed footnote does not include any assurances that these assumptions are accurate. It is important to recognize that USwww as proposed would enable Federal Government FSS users to locate earth stations in the heart of major metropolitan areas and *shut down earlier-licensed* Fixed transmitters that might cause harmful interference into the earth stations. Because Cisco expects many of these stations to be owned and operated by end users rather than carriers, any given shut-down could have catastrophic consequences for the enterprise involved. The Federal Government's right to insist on such a shut-down must accordingly be limited very, very strictly. Cisco is not aware of any publicly available link budgets for satellite operations in these frequencies, and therefore has not been able to calculate the extent to which the siting of a satellite earth station in the 74-76 GHz band may preclude deployment (or continued operation) of co-frequency Fixed stations in the same vicinity. Before footnote USwww is adopted, the Commission should insist on the appropriate assurances from current or potential Federal Government users regarding the scope and location of FSS operations in these frequencies, and ideally these assurances should be used to formulate limitations on the footnote that will give Fixed, Mobile, and Broadcasting *users* the certainty they need before they can rationally invest thousands of dollars in any given radio link.[7]

[7] *See, e.g.*, 47 C.F.R. § 74.870 (listing fifteen geographic areas within which wireless video assist devices may not be used); 47 C.F.R. § 101.147(r)(9) & (10) (implementing special protection for U.S. government

What is clear already is that the proposed footnote USwww should not be expanded to protect BSS operations or non-Government FSS operations.[8] Unlike Government FSS users, commercial FSS users will attempt to deploy as many earth stations as possible, and in the absence of any evidence to the contrary one must assume that these stations will be located in major urban centers. The same assumptions would appear to be reasonable with respect to BSS operations. Giving BSS and non-Government FSS operators the right to evict previously-licensed Fixed, Mobile, and Broadcasting users in the 74-76 GHz band would be tantamount to band segmentation, which the Commission has otherwise resisted. Cisco therefore urges the Commission to limit footnote USwww to Federal Government operations (as proposed), if indeed that footnote is added at all.

Although it is impossible to draw any firm conclusions at this time about sharing scenarios involving commercial satellite operations in the W band, there is one sharing measure that Cisco believes would be appropriate without further delay: power flux-density (pfd) limits for satellite operations in the 71-76 GHz band. Because of the absence of any reliable link budget information for these frequencies, Cisco is not in a position to derive an appropriate number, either in terms of satellite power requirements or terrestrial protection requirements. However, Cisco believes that one of the factors making the V-band pfd controversies so difficult was that there was no "default" pfd limit in place for satellite operations when terrestrial

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operations, but only within specified distances from 38°48' N/76°52' W (Washington, D.C. area) and 39°43' N/101°46' W (Denver area). If, for national security reasons, the Federal Government users are unable to list geographic areas in which Federal Government FSS and BSS earth stations are located, much of the same benefit could be achieved by stating affirmatively that such earth stations are *not* located within, say, the top 50 or 100 metropolitan areas. This would resemble the approach chosen for protection of RAS in the 10.6-10.68 GHz band, 47 C.F.R. § 2.106 n.US277, and suggested in the NPRM as one possibility for protection of RAS in the W band. *NPRM* ¶ 46. In a national security context, this would allow the Federal Government to tell commercial users where the government isn't, rather than where it is.

[8] *Cf.* NPRM ¶ 22.

operators first developed the band. Cisco therefore recommends that the Commission borrow interim satellite pfd limits from the V band, with the understanding that the limits will need to be revisited whenever satellite technology for these frequencies becomes available for commercial deployment.

B. Allocation Proposals for the 81-86 GHz Band

As with the 71-76 GHz band, Cisco generally supports the Commission's allocation proposals for the 81-86 GHz band. Specifically, Cisco supports the Commission's proposals (1) to allocate the 84-86 GHz band to FSS uplinks and change the transmission direction for satellite services in the 81-84 GHz band from downlink to uplink; (2) to delete the BSS and Broadcasting allocations from the 84-86 GHz band; and (3) to revise footnote US297 in order to make 81-82.5 GHz (instead of 74-75.5 GHz) available for BSS feeder links.

Cisco also supports the Commission's decision *not* to propose a secondary Amateur and/or AMSAT allocation at 81-81.5 GHz. As noted above with regard to the 71-76 GHz band, the presence of Amateur and AMSAT operations, even on a secondary basis, could cause harmful interference to terrestrial operations that would be difficult in practice to identify and resolve because Amateur operations are not tied to any particular location. Again, the Amateur and AMSAT spectrum available at 77.5-78 GHz would appear to be fully sufficient for Amateur purposes and would relieve commercial users in the 81-86 GHz band of the threat of transient yet serious interference.

Cisco does not oppose the allocation of the 81-86 GHz band to the Radio Astronomy Service, in accordance with the Final Acts of WRC-2000; nor does Cisco oppose the consequential revision of footnotes US342 and US211. Cisco is concerned, however, about the precise parameters of proposed footnote USzzz, at least insofar as the 81-86 GHz band is concerned. The proposed footnote states that RAS is not entitled to protection from other

allocated services except within coordination zones centered on 18 enumerated RAS observatories, and Cisco fully supports this concept. However, drawing these coordination zones too broadly will impose significant costs on commercial users of the 81-86 GHz band, and will be a particularly significant impediment in those metropolitan areas that fall within the stated zones. (The Commission mentions Boston and Fresno, but might just as easily have mentioned Tucson, Phoenix, Albuquerque, Santa Fe, Maui, or Iowa City.) Moreover, the amount of interference received by the RAS from any given transmitter in the 81-86 GHz band is highly dependent not only on the location of the transmitter but also on its azimuth, and the very large coordination zones in the current version of footnote USzzz do not take this into account. Nor do the zones take into account the observatory sensitivity or terrain shielding.

To correct these deficiencies, Cisco enthusiastically supports the Commission's suggestion that the RAS observatories protected by USzzz be required to operate a single web site where terrestrial applicants can input the end points, power, and antenna characteristics of their proposed links and receive an instant answer as to whether coordination is truly required.[9] Ideally, commercial equipment makers and the observatories would work together to reduce the size of the coordination zone, so as to minimize the administrative burden on all parties. One such idea is already incorporated in the technical proposals Cisco presents below in Part V.B: a requirement that only digital modulation be used in the 71-76 GHz and 81-86 GHz bands. Whatever justification might have existed in an analog world for the large coordination zones of footnote USzzz, Cisco's proposed digital modulation requirement would sharply reduce the possibility for interference to RAS operations.

[9] NPRM ¶ 45.

The Commission also asks whether there is a need for technical or regulatory sharing rules so that satellite and terrestrial services can share the 81-86 GHz band.[10] As stated above with respect to the 71-76 GHz band, Cisco believes it would be both unnecessary and unwise to develop detailed sharing rules at this time. Cisco is not aware of any proposal for commercial satellite use of the 81-86 GHz band, nor of any other public information on what the technical characteristics of an 80/70 GHz satellite service might be. Consequently, there is currently no evidence about the extent to which Fixed transmitters in the 81-86 GHz band will interfere with space station receivers, or the extent to which satellite earth station transmitters in the 81-86 GHz band will interfere with Fixed receivers. While the impulse to deal with anticipated sharing problems in advance is commendable, in this case there is simply not enough technical information to justify the imposition of any significant sharing constraints.

III. THE COMMISSION SHOULD STRIVE FOR MAXIMUM FLEXIBILITY IN ITS BAND PLANS AND MINIMUM DELAY IN THE COORDINATION PROCESS.

In keeping with the Commission's overall emphasis on flexibility and efficiency, the Commission should generally rely on the coordination process for the prevention of harmful interference, rather than on segmentation of the band either between Government and non-Government users or between classes of commercial users. Three "band-plan" issues require more detailed comment here: pairing and channelization of the bands; Government/non-Government sharing; and satellite/terrestrial sharing.

A. The Commission Should Adopt the Loea Band Plan for Fixed Use of the 71-76 GHz and 81-86 GHz Bands.

In its original petition for rulemaking, Loea proposed that the Commission amend Part 101 of the Commission's rules to pair the 71-76 GHz band with the 81-86 GHz band for Fixed

[10] NPRM ¶ 33.

use. In addition, Loea asked the Commission *not* to channelize these bands, and instead to license the entire 2 x 5 GHz to each and every licensee. Cisco strongly endorses both of these aspects of the Loea proposal. Indeed, Loea's proposal is the only way for the American public to receive the full benefit of the two most exciting features of these bands: the amount of contiguous spectrum available, and the practically inexhaustible supply created by almost infinite frequency reuse.

The proposal to make a full 5 GHz available in each direction goes to the heart of this proceeding because the Commission's decision on that point will largely determine whether W-band technologies make any discernable contribution to our communications infrastructure. In Cisco's view, the most distinctive feature of these bands, and the most tantalizing potential of the technology, is the ability to achieve fiber-equivalent transmission rates of OC-192 and greater. In the 71-76 GHz and 81-86 GHz bands, this requires the use of a full 5 GHz in each direction. While some users may not need a gigabit per second of capacity (at least initially), nonetheless, because the spectrum can be so readily re-used, there is little or no reason *not* to authorize the full bandwidth to each user. As Loea's original petition noted, "The only resource limitation is really a spatial limitation on the number of available paths."[11] If re-use is governed principally by path geometry rather than interference away from the path, it makes little difference to the rest of society whether a given licensee uses the licensed path heavily or lightly. On the other hand, it may make a great deal of difference to potential enterprise users whether they need to make serial modifications to their licenses as their capacity needs grow. Indeed, uncertainty about the future availability of expansion spectrum may dissuade some enterprises from deploying W-band radios in the first place. Hence, both the Commission and the public would

[11] Loea Petition at ¶ 12.

benefit from making each license include the maximum possible bandwidth right from the start, with licensees permitted to use some or all of it as needed, without regulatory micromanagement.

B. The Commission Should Work with NTIA to Develop a Procedure for Instantaneous Coordination with Government Users.

In the NPRM, the Commission properly raises the question of how to facilitate sharing between commercial operations and those of the Federal Government. ***This is one of the most important issues in this proceeding, because coordination delays probably represent a bigger threat to the commercial development of the W band than actual interference problems.*** The Commission proposes "to include in the final rules specific areas proposed by NTIA during this proceeding which will require coordination with the Frequency Assignment Subcommittee (FAS) of the Interdepartmental Radio Advisory Committee (IRAC) for frequency assignments and licensing."[12] The implication is that these would be the *only* areas in which IRAC coordination is required, and if that is the case then Cisco believes this proposal is a sensible start. However, the Commission can and must do more or else coordination delays could easily prevent any meaningful deployment in the W band.

Delay is likely to be an even bigger threat to the development of the W band than actual interference would be, because coordination delays can effectively prevent commercial deployment even where actual interference would not. Although Cisco cannot know precisely what (if any) use the government is making of these frequencies, the propagation characteristics of these frequencies make it unlikely that sharing with government services will be very much more difficult than sharing among commercial users. The potential for delay, on the other hand, *could* be materially worse where government services are involved, due to the nature of the

[12] NPRM ¶ 48.

IRAC process. In short, there simply will not be any commercial success in the W band if coordination takes 4-6 months.

Cisco therefore believes the Commission should work with NTIA to jointly develop some more comprehensive clearance procedure to accommodate Government and non-Government sharing of the spectrum. Ideally, a single coordination process would govern both Government and non-Government assignments. There seems to be no reason why most Government frequency assignments could not be notified to the Commission and to any commercial path coordinators who request the information. Even if some Government assignments are classified, a unified Government/non-Government coordination process might still be possible if the Commission and NTIA were to designate one or more "Trusted Path Coordinators," similar to the existing microwave frequency coordinators, and trusted by the Government to hold even those assignments that are sensitive for national security reasons. These "Trusted Path Coordinators" would be obligated to maintain path databases that would be queried by all other path coordinators on an overnight basis for a determination as to whether the desired path is available.

Whatever specific process is developed, the two basic goals should be to keep the number of cases requiring special IRAC coordination to a bare minimum, and to make the IRAC coordination process as fast as the contemplated commercial coordination process – *i.e.*, instantaneous. Cisco has three concrete suggestions in this regard. First, all Government assignments except those that must be kept confidential for national security reasons should be recorded in the same database used by commercial path coordinators. This should sharply limit the maximum number of cases requiring IRAC coordination. Second, if it is feasible to isolate a limited number of geographic areas in which classified government operations require case-by-

case coordination, the Commission's rules should identify those areas and define a suitable coordination zone around them. This measure, combined with the first, would effectively make *most* locations in the United States subject only to a single, streamlined coordination procedure even if there is no "Trusted Path Coordinator." Third, to the extent feasible, NTIA should maintain a web site that gives an "up or down" answer for new links within a coordination zone.[13] Although this last proposal sounds very "public," and would require some administrative burden for NTIA, it might actually entail *less* public disclosure of the whereabouts of sensitive government facilities than the "reference point" method suggested in the NPRM and used in some existing rules. Adopting these measures, and any others that can reduce the number of Government/non-Government coordinations, will benefit both the public and private sectors.

C. The Commission Should Defer the Question of Satellite/Terrestrial Sharing Until the Characteristics of Both Services are Better Defined.

Finally, the Commission asks whether it should adopt sharing criteria for the 71-76 GHz and 81-86 GHz bands, similar to the band plan adopted for the 36-51 GHz band. Cisco does not believe there is any evidence that such sharing criteria are necessary at this time. In part this is because the propagation characteristics of the 70/80 GHz bands give reason for optimism that inter-service sharing will not be as problematic as it is in the 36-51 GHz band. But in large part it is simply too early to draw any reliable conclusions about co-frequency sharing because the ultimate nature of the networks deployed in these frequencies is still a matter of conjecture. Most commenters, including Cisco, seem to expect that terrestrial services in the 71-76 GHz and 81-86 GHz bands will be deployed exclusively in point-to-point rather than point-to-multipoint architectures, with more link margin and less susceptibility to satellite downlink interference

[13] Proposed footnote USzzz already adopts this approach for protection of Radio Astronomy operations. For an example of this approach in the context of national security facilities, *see* 47 C.F.R. § 101.147(r)(9) and (10).

than in lower frequencies. At the same time, there is simply no basis on which to make projections about the types of commercial satellite services that might someday be possible in these frequencies, and given the state of satellite deployment in the Ka band, not to mention the V band, it may be a decade or more before a credible commercial satellite proposal for the W band even reaches the drawing board. Under these circumstances, Cisco believes it would be unwise to impose the certain and immediate constraints that result from detailed sharing rules in exchange for speculative and in any event distant benefits that might someday result from those rules. In short, a detailed sharing plan would currently be a solution in search of a problem.

IV. THE COMMISSION SHOULD ADOPT A BLANKET LICENSING REGIME.

Loea, supported by virtually all of the parties that commented on its petition, proposes that terrestrial Fixed links in the 71-76 GHz and 81-86 GHz bands be licensed under Part 101 on a site-by-site basis. The arguments advanced in favor of this proposal are cogent: Site-by-site licensing makes possible an arbitrarily large number of licensees, each with its own "spatial pipe," and thus avoids any artificial scarcity of spectrum. The alternative of auctioning the spectrum by geographic region (either with or without "band manager" rules) would force the Commission either to channelize the bands (thus reducing data capacity), or to tolerate a spectrum monopoly of the Commission's own making. Neither of those choices would be in the public interest. Cisco therefore joins with other commenters who have urged the Commission to reject geographic licensing either to carriers or to band managers.

However, after acknowledging most of these difficulties in the NPRM, the Commission nonetheless declines to propose any licensing regime because of concerns about the administrative details of site-by-site licensing. The Commission worries, for example, that

"hundreds of thousands"[14] of new sites per year will create a material administrative burden both for the applicants and for the Commission. In addition, the Commission points out that each site-by-site authorization would require an application fee and an annual regulatory fee. And the Commission observes that if facilities are licensed on a site-by-site basis, each modification of the facilities will also require Commission approval – which in turn increases the administrative burden and the fee burden. The Commission's concerns evidently stem from the unspoken assumption that W-band radios will be licensed primarily to carriers rather than to enterprises themselves – hence the reference to the need for "hundreds of thousands of authorizations in a given area to effectuate a business plan."[15] As noted above, there is no reason to make the assumption that these bands will be used primarily by carriers. But even adjusting for this carrier-centric outlook, it seems fair to observe that traditional site-by-site licensing would require the Commission to grant significantly more individual licenses – and modification approvals – over a longer period of time than would be necessary with a one-time auction of geographic spectrum monopolies.

To address these concerns about administrative burden and post-licensing flexibility, the Commission should consider an alternative licensing regime that would combine the pro-competitive, open-entry virtues of site-by-site licensing with the administrative simplicity of geographic area licensing. Specifically, Cisco endorses a blanket licensing proposal that would work as follows: The first link requested by any applicant would be authorized according to the traditional site-by-site licensing procedure. Coordination would be completed prior to the filing of the application, and conditional operation would be permitted during the pendency of the application, in accordance with existing Part 101 rules. However, upon grant of that license, the

[14] NPRM ¶ 68.

[15] NPRM ¶ 68.

licensee could construct and operate additional links merely by (1) coordinating the new paths; and (2) notifying the Commission of their location (or hiring the path coordinator to do so).[16] As a blanket licensee, the carrier or enterprise could deploy additional links anywhere in the United States, subject to the prior coordination requirement and a requirement of notice to the Commission.[17] Similarly, if the carrier or enterprise wished to upgrade existing links (*e.g.*, for higher capacity), it would get the existing spatial pipe re-coordinated with the new equipment parameters and submit a notification to the Commission. It would not be necessary for the blanket licensee to file, or the Commission to review, a separate application for each site because the licensee's basic legal, financial, and technical qualifications would already be matters of public record. Furthermore, it is eminently reasonable for the Commission to presume that any enterprise that has already placed an authorized link into operation would be sophisticated enough to comply with the prior coordination condition(s) and all other licensee obligations without extensive Commission scrutiny of each of the individual installations.

This blanket licensing proposal would directly address many of the Commission's concerns about site-by-site licensing. First, to the extent that carriers seek to acquire large numbers of W-band links for their customers (as the Commission implicitly assumes), blanket licensing will dramatically reduce the number of applications that must be filed directly with the

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[16] Ideally, this notification process should be entirely electronic, and could perhaps be modeled on a shorter form of FCC Form 601. The Commission would periodically place all of the notifications it receives on public notice, strictly for information purposes, so that path coordinators will have a complete database to use for coordination of subsequent paths. Cisco envisions that this process will be streamlined similar to the way the Commission handles Class II design changes to transmitter certifications. This process would only entail providing the proposed changes or new site information; like a Class II change, it would not require the submission of other technical information or qualifications that are already on file.

[17] In addition, as with other geographic licensees, the Commission could insist on a separate station application for links presenting special concerns. Paragraph 88 of the NPRM, for example, proposes that even geographic area licensees would be required to file individual applications for links requiring (1) submission of an Environmental Assessment; (2) international coordination; (3) operation in quiet zones; or (4) coordination with the IRAC. NPRM ¶ 88. This proposal works just as well for blanket licensees as it does for geographic area licensees.

Commission. Second, not only carriers but also large and medium-size enterprises will benefit from the streamlined licensing of all applications.[18] Third, by eliminating unnecessary license applications, blanket licensing would also eliminate the payment and collection of unnecessary license renewal fees. Fourth, blanket licensees would have all the flexibility of geographic area licensees, resulting in fewer modification applications; any changes would be coordinated through the path coordinator. And all of these benefits would be achieved without giving any licensee the power to exclude others' use of the spectrum – as geographic licenses, by definition, do. The blanket licensing model thus permits the Commission to realize the administrative benefits and flexibility of geographic area licensing with none of the anticompetitive consequences.

Naturally, there is a need for some specialized rules (or rule adjustments) in Part 101 to make such a blanket authorization work. Beyond the basic requirements to file for the initial site license, it is imperative that each subsequent link deployed under the license be submitted to the Commission (probably by the path coordinator in most cases) and entered into the database used for subsequent coordinations. In Appendix A, Cisco attaches a set of amendments to Part 101 that would make the blanket licensing regime work. Cisco urges the Commission to adopt these rules in its Report and Order.

The very forgiving interference environment for W-band radio services might suggest in some minds the possibility of unlicensed use. Indeed, the Commission seeks comment on this alternative as well. However, Cisco believes that 70/80 GHz spectrum should be licensed, for several reasons. First, the unlicensed-use model may not provide either carriers or sophisticated

[18] Using the coordinator to add the additional sites to the electronic license file will reduce the Commission's workload. The coordinators would be able to add additional information to the files like a Telecommunication Certification Body does for a product that is being certified under the FCC rules. Currently section 2.962 of the Commission's rules establishes criteria for TCBs and their role in issuing grants and amending FCC certification files.

enterprise users with sufficient comfort that they will have the reliability they need. A user with an OC-192 link probably has a strong interest in making absolutely sure that link is protected from interference, and may desire *legal* protection from interference, rather than just a predictive judgment that interference is unlikely as a practical matter. Second, the equipment itself is likely to be different from the plug-and-play, consumer-type devices that predominate in unlicensed bands. Radios will require professional installation, and generally either roof rights or tower leases. Environmental assessments will be required in a significant number of cases. Under these circumstances, there is little to be gained from the administrative streamlining that comes from unlicensed use. Third, even though the interference environment is forgiving in random deployments, much greater care must be taken for hub-and-spoke deployments. This is in part due to the number and close proximity of radios at the hub location. Because of the importance and anticipated number of these more dense deployments, it would be unwise to permit unlicensed operation with the consequent potential disruption in service from lack of coordination.

V. CISCO GENERALLY SUPPORTS THE PROPOSED OPERATIONAL AND TECHNICAL SERVICE RULES

Despite the Commission's decision not to propose a licensing process for the 71-76 GHz and 81-86 GHz bands, the Commission did propose a number of other "operational" and "technical" service rules, sometimes proposing them in the alternative depending on the licensing scheme ultimately adopted.

A. Operational Service Rules

As discussed above, Cisco supports a blanket licensing process that combines elements of the site-by-site licensing favored by Loea and the geographic licensing process which the Commission offers as an alternative. Many of the operational rules discussed in the NPRM

apply only to geographic licensing, and therefore require no further comment here in light of the compelling reasons for rejecting geographic licensing. However, to the extent that the other operational service rules proposed by the Commission are applicable to a blanket licensing environment, Cisco generally supports them.

Specifically, Cisco supports (1) the Commission's application of the foreign ownership limitations of 47 U.S.C. § 310; (2) the Commission's decision not to impose any eligibility restrictions for competitive reasons; (3) the requirement that licensees along the Mexican and Canadian borders be subject to future coordination agreements with Mexico and Canada; (4) a ten-year license term with the same renewal expectancy that exists in other point-to-point microwave bands; and (5) application of the point-to-point construction requirement contained in section 101.63 of the Commission's rules

Cisco urges the Commission to tighten the construction requirement somewhat, giving each licensee up to 120 days to complete any and all necessary construction and bring any given link into regular use. This 120-day period would commence upon FCC licensing of the path in question in the case of the initial link; and in the case of subsequent links, upon notification by the path coordinator to the licensee that the path in question has been successfully coordinated and notified to the Commission.

The Commission seeks comment on whether it should forbear from applying certain obligations under Title II of the Communications Act to those W-band licensees who elect to operate as common carriers. Cisco believes the Commission should exercise at least as much forbearance in this case as in the case of CMRS licensees.[19] Indeed, under the proposed rules endorsed by Cisco, Title II regulation is completely unnecessary because (a) the market is

[19] NPRM ¶ 89.

completely competitive, with no incumbents and no barriers to simultaneous entry by a large number of independent licensees; (b) the technology by its very nature is "anti-bottleneck," making it difficult for any carrier to maintain any unjust, unreasonable, or discriminatory "charges, practices, classifications, or regulations"; and (c) enforcement is not necessary for consumer protection because if the consumers in question become dissatisfied with a carrier's services they can just as easily operate their own paths.

By far the most important improvement the Commission can make in the "operational" service rules, however, concerns the coordination process. Currently section 101.103 governs the coordination of fixed terrestrial stations, setting forth the ground rules that are to be observed in terms of the information to be used, the notifications to be given, the responses to be made, and the time within which this is to occur. Most of these rules can and should be applied to coordination of fixed stations in the 71-76 GHz and 81-86 GHz bands, but Cisco recommends two specific improvements: collection of better information about the equipment being coordinated, and an accreditation regime for path coordinators. Section 101.103 should be amended in these two particulars in order to promote rapid, certain, and efficient roll-out of these radio services.

First, the Commission should amend section 101.103(d)(2)(ii) to update the list of technical data that must be submitted with any coordination request. Current path coordinators have informed Cisco that under the existing rule they sometimes have difficulty getting basic information that is absolutely necessary for coordination, including transmitter and receiver metrics that are explicitly referenced in the Telecommunications Industry Association's Telecommunications Systems Bulletin TSB 10.[20] These data should be readily available in the

[20] TSB 10 provides the technical framework for most microwave coordinations.

path coordinators' databases, and the least intrusive way to ensure that they are is for the Commission to require this information to be included in every coordination request. Cisco therefore proposes that the list be amended to state that every coordination request should specify the practical threshold and required carrier-to-interference ratio of the applicant's receiver.[21] At the same time, at least one information requirement currently included in section 101.103(d)(2)(ii) can be relaxed somewhat in order to make W-band coordinations more enterprise-friendly. Specifically, the height above ground level could be supplied with +/-5-meter accuracy (which doesn't require an expensive, professional site survey to achieve), since W-band installations do not require +/- 1-meter accuracy for interference protection.[22] Experienced path coordinators participating in this proceeding may be able to supply other examples of information that should or should not be collected as a matter of course at the coordination stage.

The second improvement the Commission should make in section 101.103 is to require that all coordinations be conducted by a path coordinator accredited in accordance with standards adopted by the Commission. This would streamline the licensing and coordination process by making it possible, for the first time, for every path coordinator to share path information (both government and non-government) with every other path coordinator, so that each one's database would contain virtually the entire universe of deployed links. Additionally, this would allow all path coordinators to work from material, real-world deployment characteristics that may never show up on the face of a license or even on an FCC Form 601.

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[21] There is a question of defining the interfering source for the required C/I for the applicant receiver. Difficulties on defining the interference source have been noted in TSB 10 Annex B. Notwithstanding these difficulties, Cisco believes that the proper forum for addressing them is the TIA (see *infra* note 26).

[22] This change should also be made in § 101.21, governing the application itself.

Since virtually all microwave coordinations are already conducted by one of just a handful of professional frequency coordinators, the biggest question about Cisco's proposed accreditation regime is likely to be who will do the accrediting. Fortunately, there is no shortage of attractive possibilities. If the Commission and NTIA are able to develop a "Trusted Path Coordinator" regime, as recommended by Cisco in Part III.B above, then accreditation is easily accomplished in conjunction with the security clearance process that would be required in any event. Alternatively, since NIST/ANSI are already managing accreditations of telecommunications certifying bodies, pursuant to sections 2.960 and 2.962, it would make perfect sense for the Commission simply to require that all coordinations be conducted by a path coordinator accredited by NIST/ANSI.

Whichever body takes on the accreditation function, Cisco suggests four substantive standards on which accreditation should depend. First, a path coordinator should not be accredited unless it maintains a web-based or other electronic database that generates conclusive results (*i.e.*, results not requiring further discussion with existing licensees) for 90% or more of its coordination requests within three business days. Second, every accredited path coordinator should have a demonstrated technical expertise both with microwave or millimeter-wave radios in general and with the technical concepts contained in TSB 10 in particular. Third, each path coordinator desiring accreditation should be able to demonstrate familiarity with the coordination procedures of TSB 10 and section 101.103, as well as other regulatory requirements of the FCC's rules. And fourth, each accredited path coordinator should be required to synchronize its coordination database nightly with every other accredited path coordinator. These qualifications

are quite similar to those used by the Commission for Telecommunication Certifying Bodies,[23] and should be easy for NTIA, the Commission, or NIST/ANSI to administer.

B. Technical Service Rules

Cisco's comments regarding Technical Service Rules pertain solely to the 70/80 GHz bands. In those bands, the NPRM largely adheres to the technical proposals submitted by Loea in 2001, and Cisco agrees generally with Loea's vision for wireless broadband connectivity in the W band. However, Cisco believes that the antenna half-power beamwidth has so far been overemphasized, at the expense of other important parameters, both technical and commercial.

Two additional considerations deserve special mention. First, Cisco believes that market success for 70/80 GHz radios may require larger half-power beamwidths and smaller-diameter antennas than would be possible if the Commission were to adopt the technical rules in the NPRM. Under the rules proposed in the original Loea petition, the minimum diameter of a parabolic antenna would be in the range of 20-24 inches. With this antenna size, together with the proposed 0.6 degree half-power beamwidth, many links in this band would begin to encounter service degradation from wind loading and building sway. Moreover, smaller antennas (in the range of 12 inches) would be both cheaper and more aesthetically acceptable. Thus, both performance and market acceptance are likely to be higher if the Commission's technical rules provide for somewhat wider half-power beamwidths. However, this must be accomplished without allowing the total interference potential to increase.

Moreover, Cisco believes that the overall ubiquity of spectrum use promised by the "spatial pipe" concept will not be realized unless greater attention is paid not just to antenna gain, but to the overall antenna radiation pattern envelope ("RPE") and Automatic Transmitter

[23] 47 C.F.R. §§ 2.960 and 2.962.

Power Control ("ATPC"). In Cisco's computer simulations of two likely deployment models (the "random" model and the "hub-and-spoke" model[24]), Cisco has found that the sidelobe and backlobe performance of antennas in the 70/80 GHz band is just as important as the antenna's half-power beamwidth. In simulations of the hub-and-spoke model, where "spoke" interference will be arriving at closely spaced azimuthal angles and the antenna's RPE may not provide sufficient attenuation, Cisco has found that ATPC is the most essential element, especially when the hub location is experiencing heavy rainfall.

With these considerations in mind, Cisco has refined the original Loea proposal into a package of interrelated technical specifications that will allow higher-density use of the W band within urban deployment scenarios.

1. Pairing and Channelization. The most important of the Commission's technical service rules is undoubtedly the proposal to pair the 71-76 GHz and 81-86 GHz bands and make the full 5 GHz available in each direction without channelization. Cisco enthusiastically supports this proposal. Making the entire 2 x 5 GHz available for each authorized "spatial pipe" will empower enterprises to start with lower bandwidths and less expensive equipment yet get the benefit of an "upgrade path" to follow, simply by re-coordinating the path as bandwidth usage becomes more intensive.

In the paired 70/80 GHz bands, licensees should only be permitted to use frequency division duplexing ("FDD"). In a hub-and-spoke network, time division duplexing ("TDD") would cause harmful interference between radio terminals located at the hub. In general, when one radio terminal with a high-powered transmitter is transmitting, nearby terminals would be attempting to receive weak signals from their distant terminals in the same band. It would be

[24] See *supra* note 3 for an explanation of each model.

virtually impossible to synchronize the transmissions of the different radios unless all the radios at the hub were provided by the same equipment manufacturer and operated by the same licensee.[25] If TDD operations were permitted, the first (TDD) radio deployed at or near a hub location could effectively sterilize that area and severely limit access to important locations such as fiber hotels. By contrast, FDD operations allow for higher spatial re-use and greater flexibility when equipment from different manufacturers is deployed. In a typical hub-and-spoke deployment, all inbound links would be in one band with all outbound links in the other band.

2. Interference Protection Criteria. The NPRM asks whether any of the interference protection criteria in section 101.105 would be appropriate for use in the 70/80 GHz band in the event that geographic licensing is not used. Cisco believes that section 101.105 can be applied to the 71-76 GHz and 81-86 GHz bands without amendment as long as TIA's Telecommunications Systems Bulletin TSB 10 is updated for application in these much higher frequency ranges.[26] To be sure, the criteria for co-channel interference in subparagraph (c)(2) are much, much too stringent for the 70/80 GHz band, but because these criteria are only to be used when TSB 10 guidelines cannot be used, Cisco believes the first order of business should be to refine TSB 10 and make it as widely applicable as possible before addressing rules for non-TSB 10 situations.

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[25] In this case, the TDD frame times (frame time is time allotted for transmission in one direction followed by time for transmission in the other direction—which is then repeated indefinitely) would all be the same and synchronization would be possible (*e.g.,* via GPS). However, in general, equipment from different manufacturers would employ different frame times, so that eventually the frames of different radios would "walk through each other."

[26] Cisco is a member of TIA, and hopes to work with other TIA members in order to complete an appropriate revision of TSB 10 before the Commission adopts service rules for the 71-76 GHz and 81-86 GHz bands. Some of the more important topics for further work within TIA include rain fade modeling (particularly the issue of rain fade correlation for interference analysis) and issues related to Automatic Transmitter Power Control in 70/80 GHz systems.

3. Restrictions on Total Radiated Power and Antenna Directionality. Cisco supports the proposal for a maximum EIRP of +55 dBW per polarization. As the Commission notes,[27] this value has been used in other frequency bands subject to Part 101.

Loea proposes a minimum 50 dBi gain and a 0.6 degree half-power beamwidth. Cisco believes it is important to provide greater flexibility for 70/80 GHz radio users and antenna manufacturers by allowing choices between antenna beamwidth and EIRP. Interference potential is managed by reducing the allowable EIRP when using a wider-beam, lower-gain antenna. The Commission can manage the interference environment by specifying a maximum permitted transmitter power, independent of antenna gain. Cisco proposes a minimum antenna gain of 43 dBi, a maximum half-power beamwidth of 1.2 degrees, and a maximum transmitter power of 3W (5 dBW) while maintaining the overall constraint of a maximum EIRP of +55dBW.

The maximum transmitter power spectral density should be limited to 65 mW per 100 MHz, in order to ensure a relatively homogenous power usage across the band. This should make interference calculation more accurate for path coordination in this unchannelized spectrum, and will have the additional benefit of encouraging the use of these frequencies for high-data-rate systems. Note that the 65 mW/100 MHz value adds up to more than 3W in a 5 GHz band. This accounts for the likelihood of guard-band to manage out-of-band emissions.

As noted above, Cisco believes the entire radiation pattern envelope is relevant, not just the antenna gain and half-power beamwidth. Accordingly, Cisco proposes to require all 70/80 GHz antennas to meet the following co-polar and cross-polar RPEs.[28]

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[27] NPRM ¶ 100.

[28] Cisco agrees with the current provision in section 101.117 regarding linear polarization, and believes that 70/80 GHz radios should be required to operate with linear vertical and horizontal polarization only. Cisco further proposes that the same polarization must be used for both directions of transmission in the spatial pipe. This will provide polarization discrimination, thereby reducing interference between links, which increases spatial

Minimum radiation suppression to angle in degrees from center-line of main beam (dB)								
	1° to 5°	5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
Co-polar	15	35	40	45	50	50	55	55
Cross polar	25	45	50	50	55	60	60	60

In addition, Cisco believes all antennas should provide at least 25 dB of cross-polar discrimination between 0 and 1 degree off boresight. Cisco has researched published experimental data on rain-induced depolarization and found the environment should permit at least 20 dB of cross-polarization discrimination. We have therefore proposed slightly higher minimum antenna performance so that the environment will be the limiting factor while remaining within the range that is achievable by commercially viable antennas. All of these requirements for antenna performance will reduce interference and increase spatial efficiency.

4. Automatic Transmitter Power Control. Automatic Transmitter Power Control ("ATPC") reduces interference, particularly in hub-and-spoke networks, and Cisco urges the Commission to mandate a minimum ATPC range and adopt a simple pair of conditions for its use. To see why this is necessary, consider the classic near-far case where one link in a hub-and-spoke network has a 3-km path length, and the neighboring link has a 1-km path length. In the rain, the rain loss[29] in the 3-km link could be 3 km*15 dB/km = 45 dB, and the rain loss in the 1-km link could be 1 km*15 dB/km = 15 dB. These levels of rain loss would cause the carrier

Continued . . .

efficiency. The use of circular polarization could negate this polarization discrimination benefit, and thus could increase interference potential.

[29] Based on Recommendation ITU-R P.838-1, 15 dB/km represents a rainfall rate of approximately 40 millimeters per hour.

level of the 3-km link to drop by 45 dB but the interference level from the 1 km link to drop by only 15 dB. This would result in a 30 dB drop in C/I in the long link, potentially causing that link to fail. If the transmitter on the short link were to reduce the transmit power from maximum to that required for link closure, the longer link would not fail in the rain.

Cisco therefore proposes two specific rules regarding ATPC. First, the Commission should require minimum ATPC range (in dB) equal to 40 – {55 – maximum EIRP(dBW) of the radiating device}, or 0 dB, whichever is greater. Higher power transmitters inherently have a greater potential for interference and, therefore, must require greater ATPC range to minimize interference to others on shorter paths.[30] Second, the Commission should require transmit power to be adjusted such that one of the following conditions is met:

(a) C/N at receiver is no greater than 10 dB above TSB-10 threshold (the level at which BER is degraded to 10^{-6}); or
(b) the transmitter has reduced its output power to the specified minimum.

These rules on ATPC should govern the transmitter's output power in the following manner. During clear air conditions, the ATPC function causes the transmitter's output power to be reduced so that the signal received by the distant endpoint is no higher than 10 dB above its TSB 10 threshold. Note that in some links, especially shorter ones, it may be the case that when the transmitter has reduced its output power as required by the ATPC range specification, the signal received by the distant endpoint is still higher than 10 dB above its TSB 10 threshold; this is the reason for rule (b). Then as propagation conditions change during rainfall, the ATPC functions to increase or decrease transmitter power as needed and in keeping with ATPC regulations.

[30] This use of ATPC is consistent with 47 C.F.R. § 101.113(a).

5. Out-of-Band Emissions and Frequency Tolerance. Because a full 5 GHz will be available in each direction without channelization, it is unnecessary for the Commission to promulgate any rules on frequency tolerances. All that is necessary is for the Commission to enforce absolute limits on the amount of radiated power outside of the 71-76 GHz and 81-86 GHz bands. Section 101.111(a)(2)(ii) currently contains limits on emissions, but these limits were developed for much lower frequencies and need to be adjusted significantly in order to be appropriate in higher frequencies.[31] Therefore Cisco proposes that for transmitters operating in the 71-76 GHz or 81-86 GHz bands all emissions less than 1 GHz outside of the band shall not exceed an EIRP of (7-8*F) dBm/MHz, where F is defined as the frequency excursion beyond the band edge in GHz. For transmitters operating in the 71-76 GHz or 81-86 GHz bands, all emissions more than 1 GHz outside of the band shall not exceed an EIRP of –1 dBm/MHz. This will adequately protect systems outside the 70/80 GHz bands without imposing undue burdens that would impede the goal of ubiquitous deployment of these systems.

The Commission notes Loea's proposed frequency tolerance but also asks whether it is necessary for the Commission to promulgate such a requirement in the W band. In the 70/80 GHz bands, it is unnecessary to specify any frequency tolerance because the bands will not be channelized and the adjacent bands are fully protected by the proposed emissions rules.

6. Digital Modulation. The Commission should require digital modulation in the 70/80 GHz band. The band should not be used for analog modulation, or for unscrambled digital data.

[31] With 47 C.F.R. § 101.111 as a framework, but analogous to 47 C.F.R. § 15.407, the undesirable out-of-band emissions are given in terms of maximum EIRP level in dBm/MHz. We convert to dBm/MHz as follows: The maximum EIRP level is 55 dBW. We assume the maximum practical occupied bandwidth will be 3800 MHz, resulting in 55-10*log10(3800)+30 = 49dBm/MHz. We allow for a reasonable attenuation of 42 dBc at the band edge and 50 dBc attenuation 1-GHz away from the band edge. Considering the propagation loss in the W-band is much higher than at 15 GHz (47 C.F.R. § 101.111(a)(2)(ii)), Cisco proposes to relax these out-of-band emissions limits by 6dB, which should still not result in undue interference. This results in 7 dBm/MHz maximum EIRP at the bandedge and –1 dBm/MHz 1 GHz away from the band edge.

This formal restriction will make harmful interference to RAS less likely, without prohibiting any type of use that would be particularly likely in any event.

VI. CONCLUSION

The Commission's decisions in this proceeding can and should have a significant and positive economic impact not just on the telecommunications sector but on the economy as a whole. By making a significant amount of spectrum available in the 71-76 GHz and 81-86 GHz bands, and by optimizing the service rules to promote high-density, broadband deployment in those frequencies, the Commission will be exercising its core spectrum management function in a way that promotes the public interest and contributes to the well-being of Americans of all walks of life.

For these benefits to be realized, however, the Commission must fashion its licensing, coordination, and service rules to meet the needs of enterprises as well as carriers.

- Successful development of these bands requires that the Commission *license* the spectrum, in order to give businesses the certainty they will demand for their broadband infrastructure. Furthermore, the Commission should license *in paths* rather than geographic areas, in order to avoid an untenable choice between inadequate channel bandwidths or inadequate competition. *Blanket licensing* will allow the Commission to achieve path-based licensing without the administrative burden and expense of which the NPRM warns.

- Successful development of these bands will also require the Commission to *make coordination and authorization of the paths as fast, easy, and inexpensive as possible.* To some extent, this will require the Commission to work concertedly, in cooperation with NTIA, to minimize the extent of incompatible Government use and make Government/non-Government coordination either simultaneous with or comparable to coordination between non-Government users. The Commission can streamline the coordination process and make sure it goes faster, and it should take this opportunity to do so.

- At the same time, technical rules should be used to promote high data rates and the high deployment densities that are possible in these frequencies. This can be done by adopting

technical rules that promote the grouping of spectrum neighbors with compatible characteristics, as Cisco has proposed here.[32]

Toward these ends, Cisco respectfully submits the proposals contained herein for the Commission's consideration, and urges the Commission to adopt them.

Respectfully submitted,

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[32] *Cf.* Spectrum Policy Task Force Report at 22, 64 (recommending the creation of spectrum "neighborhoods" of systems with compatible characteristics).

APPENDIX A

PROPOSED AMENDMENTS TO PART 101

The Federal Communications Commission proposes to amend 47 C.F.R. Part 101 as follows:

PART 101 – FIXED MICROWAVE SERVICES

1. The authority citation for Part 101 continues to read as follows:

AUTHORITY: 47 U.S.C. 154 and 303, unless otherwise noted.

2. Section 101.21 is amended by revising the "NOTE" immediately thereafter to read as follows:

§ 101.21 Technical Content of Applications

* * * * *

NOTE: The position location of antenna sites shall be determined to an accuracy of no less than ± 1 second in the horizontal dimensions (latitude and longitude) and ± 5 meters in the vertical dimension (ground elevation) with respect to the National Spatial Reference System.

* * * * *

3. Section 101.63 is amended by revising paragraph (a) to read as follows:

§ 101.63 Period of Construction; Certification of Completion of Construction

(a) Each Station authorized under this Part, except in Local Multipoint Distribution Services, the 24 GHz Service, the 38.6-40.0 GHz band, and the 71-76 GHz and 81-86 GHz bands, must be in operation within 18 months from the initial date of grant. Each Station in the 71-76 GHz and 81-86 GHz bands must be in operation within 120 days of the initial date of grant if it is the first Station authorized to that licensee; or, in the case of subsequent Stations, within 120 days of notification by the path coordinator to the licensee that the path in question has been successfully coordinated and notified to the Commission.

* * * * *

4. Section 101.101 is amended by adding two new entries in numerical order as follows:

§ 101.101 Frequency Availability

Frequency band (MHz)	Radio Service				
	Common carrier (Part 101)	Private radio (Part 101)	Broadcast auxiliary (Part 74)	Other (Parts 15, 21, 22, 24, 25, 74, 78 & 100)	Notes
*	*	*	*	*	**
71,000-76,000	CC……..	OFS……	……	…….	F/M/TF
81,000-86,000	CC……..	OFS……	……	…….	F/M/TF
*	*	*	*	*	**

5. Section 101.103 is amended by adding one new item to the list of items in subparagraph (d)(2)(ii), revising the "NOTE" immediately thereafter to read as follows, and adding a new paragraph (j) as follows:

§ 101.103 Frequency Coordination Procedures

* * * * *

(d) * * *

* * * * *

(2) * * *

* * * * *

(ii) * * *

* * * * *

Practical threshold of the receiver to be coordinated

NOTE: The position location of antenna sites shall be determined to an accuracy of no less than ± 1 second in the horizontal dimensions (latitude and longitude) and ± 5 meters in the vertical dimension (ground elevation) with respect to the National Spatial Reference System.

* * * * *

(j) In the 71-76 GHz and 81-86 GHz bands, stations authorized under this Part must be coordinated by a path coordinator that is accredited by NIST/ANSI. Cisco has suggested that accreditation be performed by [NIST/ANSI]. In order to qualify for accreditation, the path coordinator must have the following minimum qualifications:

(1) The path coordinator must maintain a web-based or other electronic database that generates conclusive results (*i.e.*, results not requiring further discussion with existing licensees) for 90% or more of its coordination requests within three business days.

(2) The path coordinator must have a demonstrated technical expertise both with microwave or millimeter-wave radios in general, and with the technical concepts contained in the Telecommunications Industry Association's Telecommunications Systems Bulletin TSB 10 in particular.

(3) The path coordinator must have a demonstrated familiarity with the coordination procedures of TSB 10, this section 101.103, and other regulatory requirements.

(4) The path coordinator must synchronize its coordination database nightly with every other accredited path coordinator.

* * * * *

6. Section 101.109 is amended by adding two entries in numerical order to the table in paragraph (c) as follows:

§ 101.109 Bandwidth

* * * * *

(c) * * *

Frequency band (MHz)	Maximum authorized bandwidth
*	*
71,000-76,000	5,000 MHz
81,000-86,000	5,000 MHz
*	*

* * * * *

7. Section 101.111 is amended by adding a new new subparagraph (a)(2)(v), as follows:

§ 101.111 Emission limitations

(a) * * *

*** * * * ***

(2) * * *

* * * * *

(v) Notwithstanding subparagraph (a)(2)(ii), transmitters in the 71-76 GHz and 81-86 GHz bands shall ensure (A) that emissions less than 1 GHz outside of the band do not exceed an EIRP of (7-8*F) dBm/MHz, where F is defined as the frequency excursion beyond the band edge in GHz; and (B) that emissions more than 1 GHz outside of the band shall not exceed an EIRP of –1 dBm/MHz.

* * * * *

8. Section 101.113 is amended by adding four two entries in numerical order to the table in paragraph (a), adding an explanatory note to the two new entries immediately following the table, and revising paragraph (b) to read as follows:

§ 101.113 Transmitter power limitations

(a) * * *

Frequency band (MHz)	Maximum Allowable EIRP	
	Fixed (dBW)	Mobile (dBW)
*	*	*
71,000-76,000[11]	+55	+55
81,000-86,000[11]	+55	+55
*	*	*

* * * * *

[11] The 55 dBW lim it applies per polarization. The maximum transmitter power is limited to 3 watts (5 dBW) and the maximum transmitter power spectral density is limited to 65 mW per 100 MHz.

(b) (1) The power of transmitters that use Automatic Transmitter Power Control shall not exceed the power input or output specified in the instrument of station authorization. The power of non-ATPC transmitters shall be maintained as near as practicable to the power input or output specified in the instrument of station authorization.

(2) In the 71-76 GHz and 81-86 GHz bands, all stations authorized under this Part are required to use ATPC with a minimum range (dB) = 40 – {55 – maximum EIRP in dBW of the radiating device}, or 0 dB, whichever is greater. Transmit power for these stations must be set such that one of the following two conditions is met at all times: (i) C/N at the receiver is no greater that 10 dB above the threshold specified in Telecommunication Systems Bulletin TSB 10 (the level at which BER is degraded to 10^{-6}); or (ii) the transmitter has reduced its output power to the required minimum specified in this subparagraph.

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9. Section 101.115 is amended by adding new entries in numerical order to the table in paragraph (c) and adding a note to the new entries immediately following the table, as follows:

§ 101.115 Directional Antennas

* * * * *

(c) *** * ***

*** * * * ***

Frequency (MHz)	Category	Maximum beamwidth to 3dB points (incl. angle in degrees)	Minimum antenna gain (dBi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
*	*	*	*	*	*	*	*	*	*	*
71,000 to 76,000 (co-polar) [15]	A	1.2	43	35	40	45	50	50	55	55
	B	1.2	43	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar) [15]	A	1.2	43	45	50	50	55	60	60	60
	B	1.2	43	45	50	50	55	60	60	60
81,000 to 86,000 (co-polar) [15]	A	1.2	43	35	40	45	50	50	55	55
	B	1.2	43	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar) [15]	A	1.2	43	45	50	50	55	60	60	60
	B	1.2	43	45	50	50	55	60	60	60
*	*	*	*	*	*	*	*	*	*	*

* * * * *

[15] In addition to the specifications in the chart above, antennas in these bands must also meet the following standards for minimum radiation suppression at angles of between 1 degree and 5 degrees from the centerline of main beam: in both Category A and Category B, co-polar discrimination of at least 15 dB, and cross-polar discrimination of at least 25 dB. Cross-polar discrimination shall also be at least 25 dB between 0 and 1 degree from centerline of main beam in both Category A and Category B.

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10. Section 101.147(a) is amended by adding two entries in numerical order to the list in paragraph (a), and by adding a new paragraph (z), as follows:

§ 101.147 Frequency assignments

(a) * * *

* * * * *

71,000-76,000 MHz (4) (5) (11) (17) (19)

81,000-86,000 MHz (4) (5) (11) (17) (19)

* * * * *

(z) *Special requirements for operations in the 71-76 GHz and 81-86 GHz bands.* The 71-76 GHz band shall be paired with the 81-86 GHz band. Stations authorized under this Part in these bands shall operate with digital modulation, using frequency division duplexing. The same polarization shall be used for both directions of transmission.